

REMARKS

This is in full and timely response to the above-identified Office Action. Reexamination and reconsideration in light of the proposed amendments and the following remarks are respectfully requested.

Claim Status


Claims 1-10 and 12-26 are pending in this application (only claim 11 has been cancelled). Claims 1-9 and 26 are withdrawn from consideration due to a restriction requirement. Claims 19-22 are withdrawn due to an election requirement. The status of claim 16 is unclear and stands neither rejected nor withdrawn. Clarification of this in a further and non-final office action is requested.

Election of Species

The characterization of the election in this Office Action as having been made with traverse is incorrect. The need for the election was challenged not on the basis of not being patentably distinct but on the absence of undue load on the Examiner to examine both iron-based and nickel-based alloy based material. The Applicants made no assertion that the species were not patentably distinct.

The Applicants assert that the Patent Office has taken the position that the claimed material which is withdrawn from consideration as a result of this requirement, is patentably distinct and that it can be prosecuted in accordance with 35 U.S.C. § 121 in a divisional application with impunity from any assertion of double patenting.

Priority

The Examiner is respectfully requested to acknowledge receipt of the priority papers in any subsequent paper issued in connection with this application. 

The Specification

The specification has been amended to correct the spelling errors noted in paragraph #6 of the Office Action.

Rejections Under 35 USC § 102

The amendment of claim 10 to include the subject matter of claim 11 which is acknowledged as not being anticipated by the art of record, renders moot the anticipation rejections of claims 10, 12, 13, 14, 15 17 and 23-25 under 35 USC § 102(b) in light of either of Skarpelos et al. or Uetake et al.

Rejections Under 35 USC § 103

The characteristic features of the present invention are recited in amended Claim 10. Specifically, the characteristic features are that both a photocatalytic substance (e.g., TiO₂) and a noble metal (e.g., Pt) are applied on a surface of a reactor structural member in order to reduce a corrosion potential of the reactor structural member.

According to the claimed invention, the corrosion potential of the reactor structural member can be reduced without injecting hydrogen into the reactor water or by injecting a small amount of hydrogen into the reactor water to extend the life of the reactor structural member. Please note that the noble metal (e.g., Pt) enhances the corrosion potential reducing effect of the photocatalytic substance.

With the claimed invention, it is possible to suppress the increase of the dose rate of the turbine system due to migration of volatile ammonia produced by the reaction of hydrogen injected into the nuclear reactor with N-16 produced by nuclear reaction. Therefore, various facilities to reduce excess hydrogen in the off-gas system by recombination can be reduced.

Furthermore, since only a very small amount of the noble metal is necessary, the oxidation and hydrogenation of the fuel material are not substantially promoted.

None of the cited references disclose both a photocatalytic substance (e.g., TiO₂) and a noble metal (e.g., Pt) being applied on a surface of a reactor structural member in order to reduce a corrosion potential of the reactor structural member.

1) The rejection of claims 11 and 18 as being unpatentable over Uetake in view of Hettiarachchi et al. is respectfully traversed.

In this rejection it is asserted that Uetake discloses all of the claimed subject matter except for having a platinum surface on which titanium dioxide forms. The rejection further indicates that Uetake further does not disclose the injection of hydrogen or the use of a nickel base alloy for the structural member.

Uetake discloses that low solubility metal (e.g., Ti) is injected into reactor water in order to reduce radioactivity in the reactor water by depositing the metal on fuel rods. At column 3, lines 1-9, it is indicated that the approach to corrosion control is to either dip the fuel clad tubes into a metal oxide suspension or flame spray the metal oxide onto the fuel clad tubes. Problem – efficiently reduce radioactivity in BWR water. Solution – provide coatings and accelerate crud deposition (see column 1, lines 55-67).

A review of the disclosure of the whole of this reference, indicates that no other measures are deemed necessary and that the disclosed technique is considered adequate for achieving the stated objects.

It is submitted that it is the knowledge of a problem that provides a reason for a person of ordinary skill, who must proceed with a total lack of any knowledge of the claimed subject matter and without any inventive activity, to apply his or her skill to the solution. Without this knowledge, the person of ordinary skill is without motivation and thus would not, in this situation, be able to proceed to combine the teachings of Uetake and Hettiarachchi in the manner purported to be obvious in this office action. That is to say, the lack of any disclosure and therefore the lack of any knowledge of the need for further corrosion control, would leave the person of ordinary skill with no motivation to consider any teachings in Hettiarachchi let alone to consider a transfer of teachings from Hettiarachchi to Uetake.

Further, Uetake neither discloses nor suggests that both a photocatalytic substance and a noble metal are applied on a surface of a reactor structural member in order to reduce a corrosion potential of the reactor structural member. The present invention and the art of Uetake are different from each other in both constitution and objective.

Hettiarachchi et al. discloses that a noble metal is injected into reactor water in order to reduce corrosion potential of reactor components (please see column 7, last paragraph and column 8, lines 1 to 3). However, Hettiarachchi et al. neither discloses nor suggest that both a photocatalytic substance and a noble metal can be applied on a surface of a reactor structural member in order to reduce a corrosion potential of the reactor structural member. ?

Therefore, there are still no teachings that would lead the person of ordinary skill to consider the application of both a photocatalytic substance and a noble metal in the manner claimed. ?

2) The rejection of claim 17 under 35 USC § 103(a) as being unpatentable over Skarpelos et al. in view of Henzel, is respectfully traversed.

Skarpelos et al. (U.S. Patent 5,028,384) discloses constructing portions of a conventional steam separator and/or dryer from titanium or zirconium metal and selective oxidizing a portion of these metal surfaces (e.g., form titanium dioxide) to provide means for catalytic oxidation of ammonia to nitrates or nitrites (see column 4, line 56 to column 5, line 27). In Skarpelos et al., the catalytic oxidizing metal is used to oxidize radioactive volatile nitrogen compounds to non-volatile forms (see column 4, lines 43 to 55, and Claim 9).

However, Skarpelos et al. does not disclose or suggest that both a photocatalytic substance and a noble metal are applied to a surface of a reactor structural member in order to reduce a corrosion potential of the reactor structural member per se. The present invention and Skarpelos et al. are therefore different in both constitution and objective.

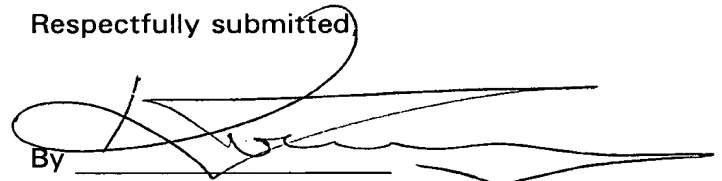
Henzel (German Patent 1997DE-1021080) discloses a method of inhibiting corrosion of a nuclear component by applying titanium or zirconium to an oxidized surface of a material such as austenitic steel. Henzel also does not disclose or suggest that both a photocatalytic substance and a noble metal are applied on a surface of a reactor structural member in order to reduce a corrosion potential of the reactor structural member.

Accordingly, the combination of the teachings of Skarpelos et al. and Henzel, when taken as a whole, would not lead the hypothetical person of ordinary skill in the direction of the purportedly obvious combination.

Conclusion

None of the cited references can be relied upon to either disclose or suggest the above-mentioned advantageous effects that can be obtained by the present invention.

Respectfully submitted

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MARKED-UP VERSIONS OF AMENDED PARAGRAPHS

Page 3, lines 32 – Page 4, line 9:

The present invention has been made to solve those problems in the related art and it is an object of the present invention to provide a reactor structural member and a method of reducing corrosion of the reactor structural member capable of reducing the respective amounts of hydrogen and noble metal to be injected into the reactor water to prevent stress-corrosion cracking, of reducing the transfer of radioactivity to the turbine system, of reducing excess hydrogen in the off-gas system, of reducing the amount of a noble [meal] metal adhering to the surface of the fuel material to the least necessary extent, and of reducing the corrosion potential of members of the primary system of a nuclear reactor by suppressing the production of loose iron particles on the surface of the fuel without promoting the oxidation and hydrogenation of the fuel material.

Page 4, line 28 – page 5, line 6:

The photocatalytic substance is a substance having a property of an n-type semiconductor, such as any one of compounds including TiO_2 , ZrO_2 , PbO , BaTiO_3 , Bi_2O_3 , ZnO , WO_3 , SrTiO_3 , Fe_2O_3 , FeTiO_3 , KTaO_3 , MnTiO_3 , and SnO_2 . These compounds are stable in a high-temperature, high-pressure, radioactive environment, and [does] do not significantly increase the migration of radioactivity to the turbine system, and [does] do not significantly promote the oxidation and hydrogenation of the fuel material. The corrosion potential of the structural members of the primary system of a nuclear reactor can be controlled by attaching any one of those compounds to the structural members of the nuclear reactor or by forming a film of the compound on the surface of the structural members of the nuclear reactor. Preferably water quality is controlled. The radioactivity of the fuel material and the activated compound is low.

Page 5, lines 24-30:

The photocatalytic substance, the [phtocatalyst] **photocatalyst** forming substance, the photocatalytic substance combined with a noble metal, such as Pt, or the [phtocatalyst] **photocatalyst** forming substance combined with a noble metal, such as Pt, is attached to the surface of a structural member of a nuclear reactor. A film of the substance may be formed on the surface of a structural member of a nuclear reactor.

Page 13, lines 18-30:

When an Fe-base alloy on which an inner layer of a p-type semiconductor and an outer layer of an n-type semiconductor are formed, such as a stainless steel, is used, the n-type semiconductor of an oxide forming the outer layer is made unstable to expose the p-type semiconductor of an oxide in a contact interface by increasing the hydrogen concentration of the [rector] **reactor** water, or the n-type semiconductor of an oxide forming the outer layer can be removed by decontamination. The corrosion potential of the member can be further lowered by bringing the p-type semiconductor of an oxide, and an n-type semiconductor, such as TiO₂, i.e., a powerful photocatalytic substance, into contact.

On page 16, lines 6-17:

Fig. 3 is a graph showing the variation with time of the corrosion potential of a structural member of a stainless steel (SUS304, JIS) coated with a TiO₂ film when exposed to ultraviolet rays for [the] **an** amount of hydrogen injected into reactor water. The corrosion potential of the structural member of SUS304 decreases when the structural member is irradiated with ultraviolet rays under a condition where hydrogen is not injected into the reactor water. However, when the structural member is irradiated with ultraviolet rays under a condition where

hydrogen is injected into the reactor water, the corrosion potential of the structural member of SUS304 decreases more effectively.

Page 17, line 36 – page 18, line 24:

Fig. 6 is a graph showing the variation of the corrosion potential of a structural member of a stainless steel (SUS304, JIS) coated with a semiconductor film when the structural member is exposed to ultraviolet rays. An anode current produced by the photoelectrochemical reaction of a semiconductor must be higher than a cathode limiting current density, i.e., the density of a cathode current produced by the oxidizing components, such as oxygen and hydrogen peroxide, of the reactor water to reduce the corrosion potential. The anode current produced by the photoelectrochemical reaction of the semiconductor is dependent on the intensity of light and the mass of deposit per unit area of the semiconductor composition. The cathode current is dependent on the concentration of the oxidizing materials, such as oxygen and hydrogen peroxide, contained in the reactor water. For example, it is estimated that oxygen concentration and hydrogen peroxide concentration in a bottom part of the nuclear reactor are 200 ppb. A limiting current density of the cathode current resulting from the oxidizing substances calculated taking into account the amount of the oxidizing substances and flow conditions in the bottom part of the nuclear reactor is about 18A/m^2 . To reduce corrosion potential, the anode current must be higher than [abut] about 18A/m^2 . When a current of 18A/m^2 or higher is produced by the [photoelectrochemical] photoelectrochemical reaction, corrosion potential decreases.

Page 22, lines 6-21:

Fig. 16 is a typical view of assistance in explaining, when a member has a metal base 2 and an n-type semiconductor film 22, which is not a photocatalyst film, a process of forming a p-type semiconductor film 21 on the metal base 2.

When the n-type semiconductor film 22 is removed by chemical or electrolytic decontamination, the p-type semiconductor film 21 grows on the metal base 2 by a chemical reaction. When the n-type semiconductor film 22 is removed by laser decontamination, only Cr can be selectively left unremoved by using laser light 24 of a proper wavelength. Since a chromium oxide forms a p-type semiconductor, only the p-type semiconductor film 21 remains on the surface of the metal base 2. An n-type semiconductor film, i.e., a catalyst film, is formed on the p-type semiconductor film 21. The n-type semiconductor film overlying the p-type semiconductor film 21 exercises a high corrosion potential reducing effect.